(9) Linnaeus, 1758, described Erosaria poraria without habitat; Lamarck, 1810, quoted Senegal; and Gray, 1825, added Jamaica (from Martini, 1769); but both habitats are wrong as E. poraria is restricted to the Indo-Pacific Ocean; Sowerby, 1837, was the first to name possible localities, Ceylon and Pacific Ocean. Nevertheless, Iredale, 1935, established Amboina as type locality, but it must be rejected as E. poraria never has been collected at Amboina nor in adjacent islands: it spreads from the Eastern Pacific Islands (race E. p. scarabaeus Bory, 1827) and from the western Indian Ocean (E. poraria s. str.) to the outer borders of Indonesia only, and it does not occur between the southern coast of Java and North West New Guinea (Skroe). Therefore, Iredale's designation of the type locality of E. poraria must be replaced by Ceylon, as Schilder & Schilder, 1938, restricted E. poraria to the Indian race.

(10) Gray, 1825, described Palmadusta humphreysii without habitat; Iredale, 1939, designated Amboina as type locality, though Schilder & Schilder, 1938, had shown that this clearly separable race of P. lutea Gronow, 1781, is restricted to the area between Torres Strait, Tonga, and Sydney, whereas P. lutea s. str. occurs from Malaysia to Japan; therefore, if specimens of P. lutea (s. lat.) should be found in Amboina in future (they have not yet been found in the southern Moluccas at all!), they undoubtedly would belong to P. lutea and not to P. humphreysii. Therefore, I designate Lifu as type locality, from which Melvill & Standen, 1895, received P. "lutea var. humphreysii" and from which I possess a specimen myself (ex coll. Hervier).

(11) Reeve, 1835, described Erronea subviridis without habitat; in 1845 he described and figured a shell from Dupuch's Island as E. subviridis, which does not agree with the original description but represents the West Australian race E. s. dorsalis Schilder & Schilder, 1938; the more eastern typical E. subviridis has been first figured by Sowerby, 1870, from New Caledonia; therefore, New Caledonia should be treated as type locality of E. subviridis (instead of North Queensland designated as type locality by Iredale, 1935), and Dupuch's Island as that of E. s. dorsalis.

(12) Iredale, 1939, was right in restricting the type locality of Blasicrura kieneri schneideri Schilder & Schilder, 1938 (originally described from Melanesia and East Australia) to New Britain, supposing that we had received specimens from P. J. Schneider who collected there; later on, Schilder, 1958, named Ulamona in New Britain as habitat of the holotype.

(13) Reeve, 1845, established Palmadusta diluculum with the erroneous habitat Philippine Islands; according to Schilder & Schilder, 1938, it spreads from "Natal to Zanzibar". Steadman & Cotton, 1946, selected Natal as type locality evidently by word priority, though P. diluculum is more common farther north than on its southernmost border; nevertheless, the selected type locality Natal must be retained.

(14) Sowerby, 1832, named no habitat of Cribraria cumingii, but Gray, 1833, added "Raie tea", which was designated as type locality ("Raietea") by Iredale, 1935; Steadman & Cotton, 1946, however, incorrectly quoted Tahiti as type locality which is a better known island in the Society Islands, but which belongs to another group of islands more than 200 kilometers off.

(15) Palmadusta punctata iredalei Schilder & Schilder, 1938, was originally established with the range from "S. Melanesia to Manokwari, Queensland, Tonga, and Samoa"; the figure of a shell from Lindeman Island (Queensland) published by Iredale, 1935, was quoted among the illustrations of the new race. Steadman & Cotton, 1946, established Lindeman Island as type locality, but Schilder, 1958, designated a shell from Mope (New Britain) as holotype, which was examined personally in 1938, whereas the identity of the Lindeman shell should be regarded as not demonstrable. Therefore, Mope should be retained as type locality, I think.

(16) The holotype of || Erronea sophiae (Brazier, 1876) has been described from Makeira Harbour at San Christoval, Solomon Islands; Iredale, 1935, and Steadman & Cotton, 1946, were not justified in generalizing the exact original indication into the "type localities" San Christoval Islands and even Solomon Islands, respectively.

(17) Schilder, 1932, rechristened the invalid name Mauritia reticulata (Martyn, 1784) into M. maculifera, without naming a type locality; but as Martyn's shell is said to come from the Friendly Islands, this habitat (=Tonga Island) should be retained for M. maculifera too.

(18) Gray, 1824, described Erronea pyriformis without habitat, but in 1828 he added New Holland, whereas Sowerby, 1837, and Reeve, 1845, both quoted Ceylon. Iredale, 1935, accepted Ceylon because it "is more likely" and expressly designated Ceylon as type locality in 1939; but E. pyriformis lives also in Queensland

(where it seems to be more frequent than in India: Sowerby, 1870, Iredale, 1939, Schilders' collection); therefore, the original habitat (New Holland) must be restored, but it should be restricted to "Queensland", as Gray's description fits to the East Australian E. pyriformis (s. str.) but not to the West Australian race E. p. smithi Sowerby, 1881.

A revised list of the type localities of all living Cypraeidae will be published in another paper.

A Preliminary Report on Spawning and Related Phenomena in California Chitons

BY

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(3 Textfigures)

The California Coast has one of the richest associations of chiton species found in the world, the total number of species occurring here being exceeded only by that of the Australian chiton fauna. In the diversity of the groups making up the fauna and the large number of unique species present, the California chiton fauna perhaps surpasses that of any other area. Although they present a rich field for investigation, our California chitons have been the subjects of relatively little biological research. In the area of breeding habits, almost all our knowledge comes from four papers by Heath (1899, 1905, 1907, and 1912).

The present paper reports observations I have made during the period from 1956 to mid-1961. Fourteen species of chitons have been observed to release gametes under laboratory conditions. As far as I can determine, there have been no previous reports in the literature concerning the breeding activities of 11 of the 14 species. The larvae of six species have developed for limited periods of time in the laboratory, but I have been unable to carry the larvae of any species through to maturity. Evidence is also presented indicating that for two species the time of gamete release is correlated to the tidal cycle.

Method

My procedure for collecting and handling chitons is very simple. The animals are pried off rocks with a dull paring knife and placed in collecting jars filled with sea water. The jars are kept closed and placed in a closed collecting bag while I am in the field and when returning from the field. Unless injured, the chitons will almost invariably uncurl and attach themselves to the sides of the collecting jars. Neither individuals nor species are ordinarily segregated following collecting.

The sea water in the collecting jars is changed just before leaving the field. In the laboratory the chitons may be left in the collecting jars with the lids off or may be manually transferred into flat, open pyrex dishes. In either case fresh sea water is generally used.

Gamete release has occurred while the animals were in the closed collecting jars and while being transported between the field and laboratory; in open collecting jars in the laboratory before and after the sea water has been changed; and in open pyrex dishes. Gamete release has occurred in the laboratory when the chitons were in total darkness, and also when

they were exposed to rather bright electric lights. There is no reason to believe that one, or a combination, of these laboratory variables induces gamete release.

Whole mount preparations were made for studying the larval development. Bouin's solution and 5 percent formaldehyde in sea water were used as fixatives. The formaldehyde solution gives good preservation of the calcareous structures in larvae over a week old. It also partially dissolves the egg cases in a matter of a few days.

Grenacher's borax carmine and Heidenhain's iron hematoxylin stains were used. I obtained the best results with the carmine stain, particularly in the early larval stages where the larvae are still surrounded by their egg cases. The cytoplasm of the larval cells is quite receptive to the hematoxylin stain and does not destain easily.

Data

Tables 1 and 2 summarize my observations of gamete release. The date following the locality is that on which the specimens were collected. The specimens were collected not more than one and one-half hours before nor more than two hours following the low low tide. The "Next High Tide" is the low high tide following the low low tide. The "Next Low Tide" is the high low tide following the low high tide. All times after 2400 hours are on the date following collecting of the specimens in the field. Some of the localities shown in the tables are not listed in the tide tables. In such instances an estimate of the high and low tides has been made by extrapolation. The estimates are believed to be accurate to within 15 minutes in all cases.

1 The water was over-cooled, and the specimens behaved peculiarly.
2 The specimen was collected in a tide pool high in the intertidal zone, an unusual habitat for this species.
3 Observations were made by Mr. Daryl Sweeney.
4 The specimens released gametes while isolated in individual jars.
4a The specimen was the only one of its species collected on that date.
4b All specimens collected on this date were females.
5 The start of gamete release was not observed.
6 The specimen was killed before gamete release had ceased.
7 The eggs or the sperm were seen, but gamete release was not observed.
8 The water became so cloudy that it was very difficult to determine when any one individual began or ceased to release gametes.
9a Egg laying occurred between 0400 and 0800, October 29, 1957.
9b Egg laying occurred between 0040 and 0830, February 28, 1957.
9c Egg laying occurred between 0215 and 0730, February 15, 1957. Some of the eggs were fertilized although no cloudiness from sperm discharge was detectable in the water.
9d Gamete release occurred between 1730 and 1915, December 26, 1956.
9e Gamete release occurred between 1400 and 1700, April 19, 1957.
10 The five males started to release sperm at various times between 2130 and 2330. The exact time at which any individual started was impossible to determine due to the cloudiness of the water.
11 More than one male may have released sperm.
12 The specimen was still releasing gametes at 0130, October 15, 1961.
13 Gamete release occurred between 0130 and 0930, October 15, 1961.

Observations

The bulk of my observations has been made on various species of the genus Mopalia, and the following descriptions are based primarily upon observations of this genus. Except where specifically noted, the descriptions apply equally well to males of the genera Ischnochiton, Chaetopleura, and Placiphorella, and to the larvae of Ischnochiton (Lepidozona) californiensis (Berry, 1931) through about the third day of development.

Gamete Release

Female chitons appear to be loosely attached to the substrate during the first part of spawning. They are generally quiescent during this period but quite frequently will move several inches during the later part of spawning. The behavior of the males is less predictable. Most frequently they will remain stationary the entire time they are releasing sperm, but on

Table 1: Mopaliidae

Location	Date	♀	♂	Gamete Shedding Time Start	Gamete Shedding Time Finish	Tide Next High	Tide Next Low	Note
Mopalia ciliata (Sowerby, 1840)								
South Side, Pigeon Point[3]	30 Nov. 1956	1		2230	2330	2220	0250	
South Side, Pigeon Point[3]	30 Nov. 1956		1	2320	2430	2220	0250	
North Side, San Pedro Point[3]	25 Feb. 1957		1	2000	2030	2130	0235	
North Side, San Pedro Point[3]	25 Feb. 1957	1		2100	2215	2130	0235	
North Side, San Pedro Point[3]	25 Feb. 1957		1	2130	2220	2130	0235	
North Side, San Pedro Point[3]	27 Feb. 1957	2		2200	0100	2235	0400	1
Pescadero Point[1]	21 Mar. 1957		1	1815	1900	1600	2030	2
Sausalito[1]	25 Sep. 1957		1	0230	?	0225	0726	3, 4
Sausalito[1]	22 Oct. 1957		1	2100	?	2335	0430	3, 4
Sausalito[1]	22 Oct. 1957	1		2245	?	2335	0430	3, 4
North Side, San Pedro Point[4]	25 Oct. 1957	1		2400	0200	0130	0615	3, 4
Mission Point[1]	21 Feb. 1960	1		2100?	2200	1915	2400	5
Franklin Point[3]	22 Feb. 1960		1	2130	2200	2015	0110	6
Franklin Point[3]	27 Feb. 1960		1	2330	2430	2340	0530	
Tiburon[1]	20 Nov. 1960	1		2130?	2345	0200	0645	
Tomales Bay[1]	11 Mar. 1961	1		1900?	2130	2100	0130	5
Tomales Bay[1]	11 Mar. 1961		1	1900?	2130	2100	0130	5, 6
Tomales Bay[1]	11 Mar. 1961		1	2030	2200	2100	0130	6
Aquatic Park, San Francisco[2]	15 July 1961		1	1530	1640	1530	2020	
Mopalia, spec. nov.								
Marina, San Francisco[2]	30 Apr. 1961		1	1130?	1400	1300	1815	5
Marina, San Francisco[2]	13 May 1961		1	1530	1700	1215	1735	
Marina, San Francisco[2]	13 May 1961	2		1800	1915	1215	1735	
Marina, San Francisco[2]	13 May 1961		2	1800	1915	1215	1735	
Marina, San Francisco[2]	13 May 1961	1		1900	2010	1215	1735	
Marina, San Francisco[2]	14 May 1961		1	1200	1215	1310	1815	
Marina, San Francisco[2]	14 May 1961	1		1900	2010	1310	1815	
Aquatic Park, San Francisco[2]	15 July 1961	2		1930	2200	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961		1	1930	2200	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961	1		2230	2300	1530	2020	
Aquatic Park, San Francisco[2]	15 July 1961		1	2200	2300	1530	2020	
Mopalia lowei (Pilsbry, 1918)								
Tomales Bay[1]	11 Mar. 1961		1	2100	2200	2100	0130	6
Tomales Bay[1]	3 June 1961	1		1600	1730	1740	2240	4 a
Mopalia porifera (Pilsbry, 1892)								
Pescadero Point[3]	10 Nov. 1958	2		2130	2200	2230	0330	
Pescadero Point[3]	10 Nov. 1958		2	2145	2300?	2230	0330	8
Pescadero Point[3]	10 Nov. 1958		3?	2200?	2400	2230	0330	8
Pescadero Point[3]	5 Mar. 1959	1		2425	2450	2050	0205	
Pescadero Point[3]	5 Mar. 1959	1		0125	0210	2050	0205	
Pescadero Point[3]	5 Mar. 1959		1	2345	2415	2050	0205	
Pescadero Point[3]	14 Oct. 1961		1	2400	2425	0315	0740	
Pescadero Point[3]	14 Oct. 1961		1	2430	0100	0315	0740	
Pescadero Point[3]	14 Oct. 1961	1		2445	0105	0315	0740	
Pescadero Point[1]	14 Oct. 1961		1	0105	?	0315	0740	13
Pescadero Point[4]	14 Oct. 1961	1		?	?	0315	0740	7, 14
Franklin Point[4]	12 Mar. 1960	2		2230?	2320	2235	0420	5

[1] = Marin County [2] = San Francisco County [3] = San Mateo County
[4] = Monterey County [5] = Los Angeles County